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FIG. 1

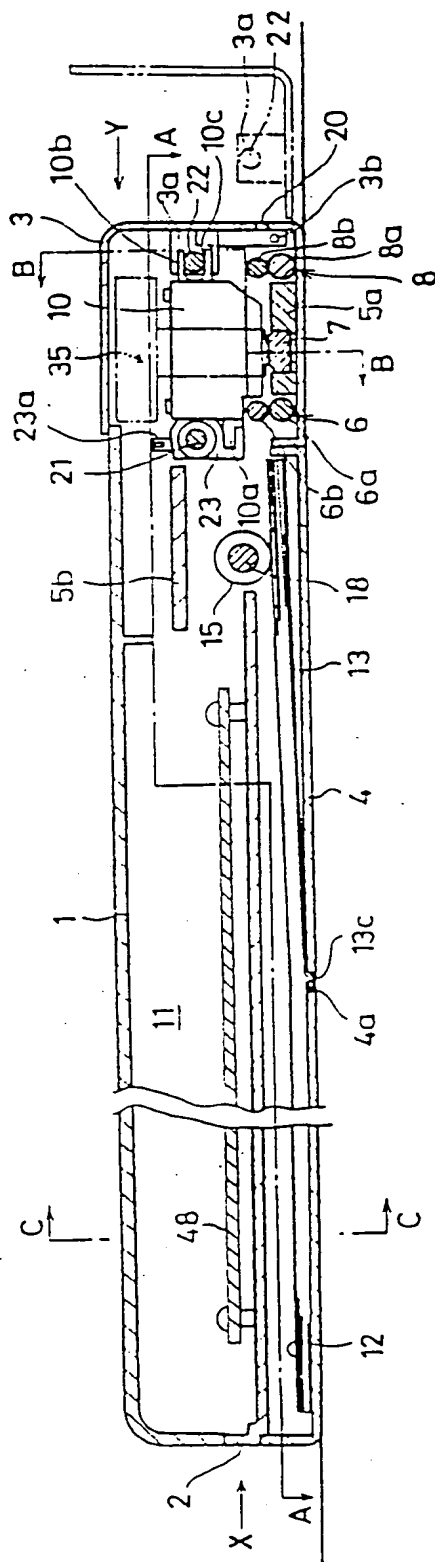


FIG. 2

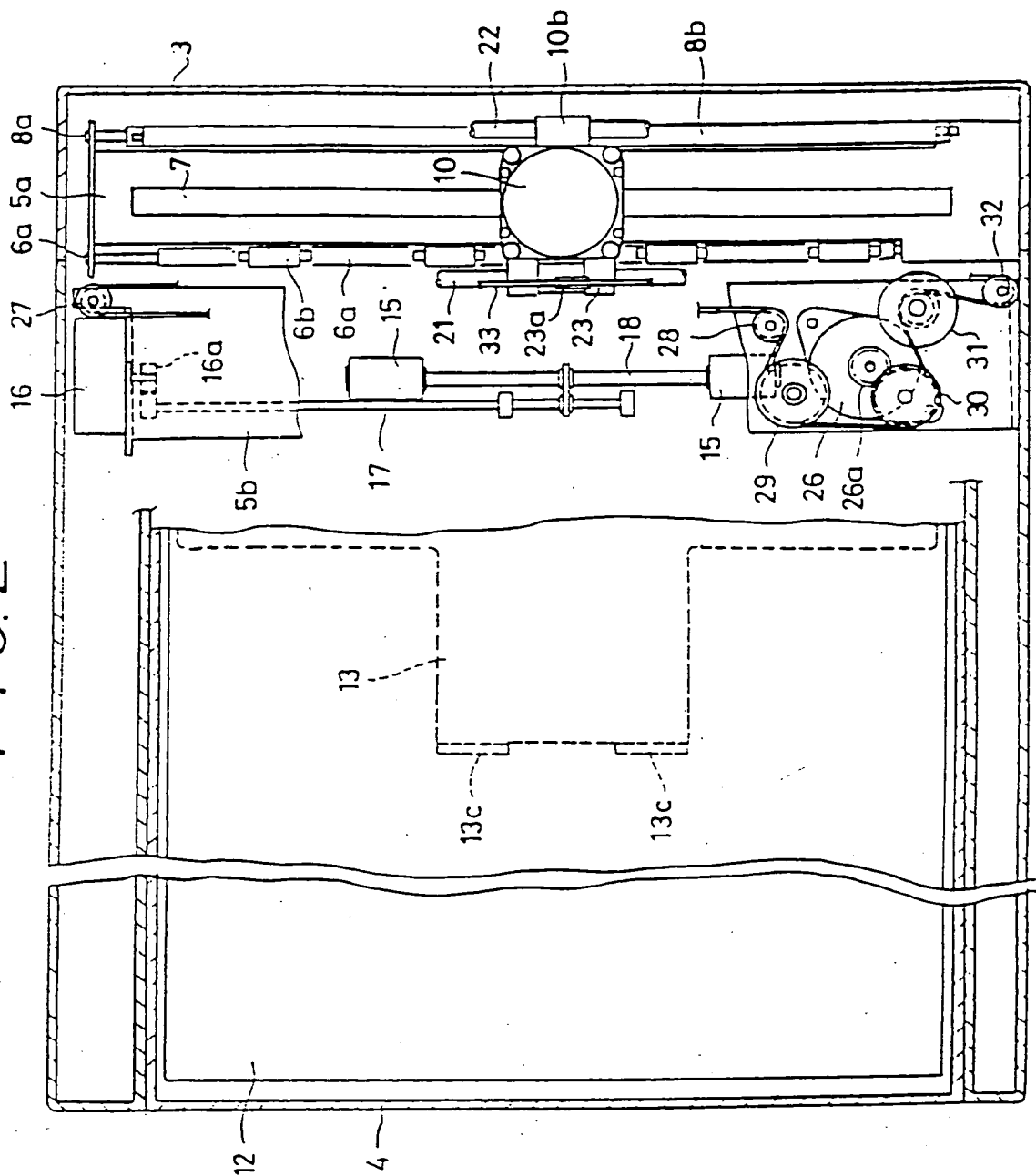


FIG. 3

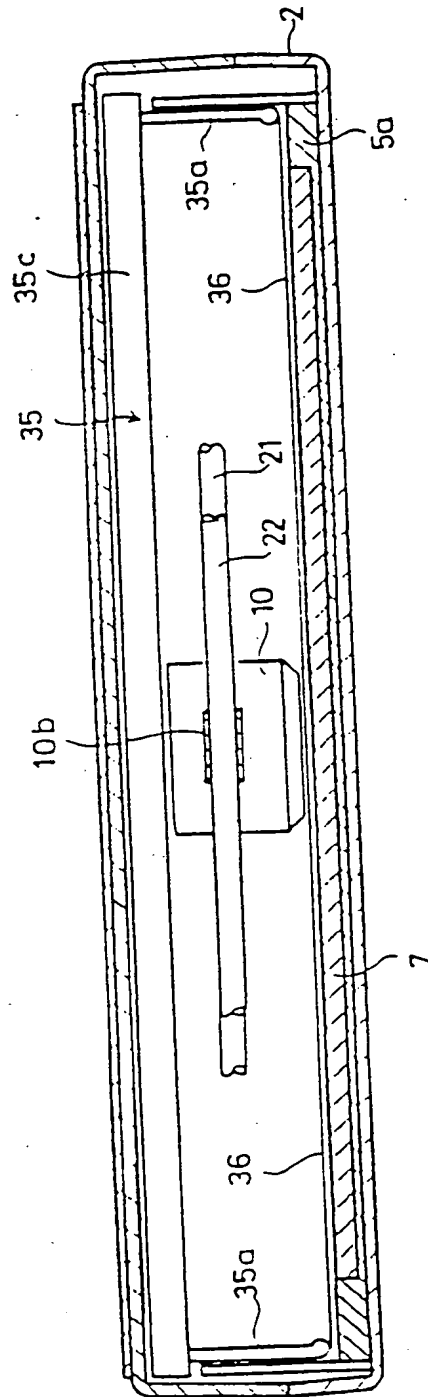
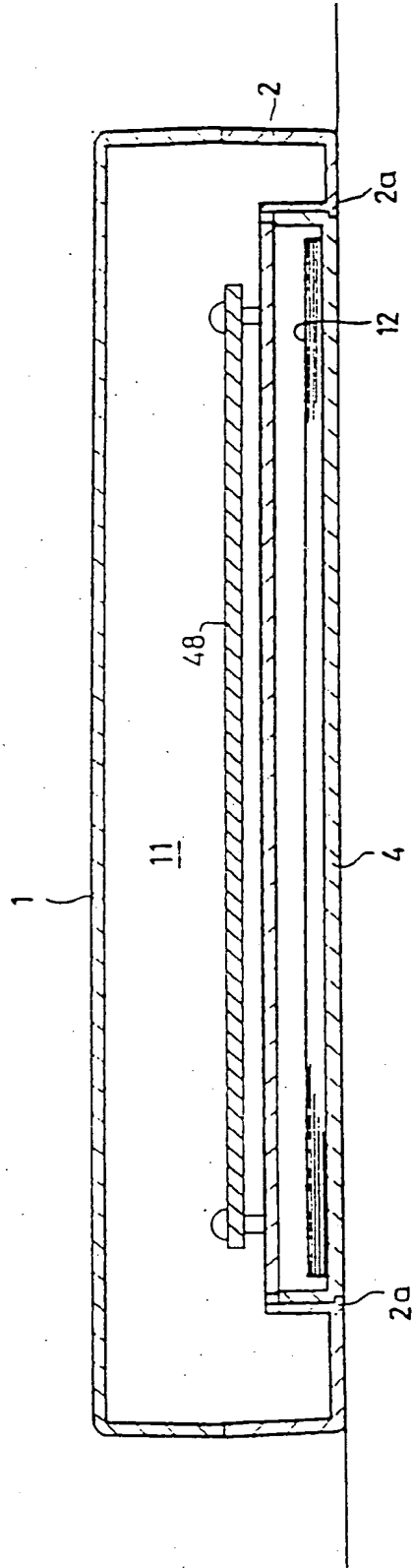


FIG. 4



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FIG. 5

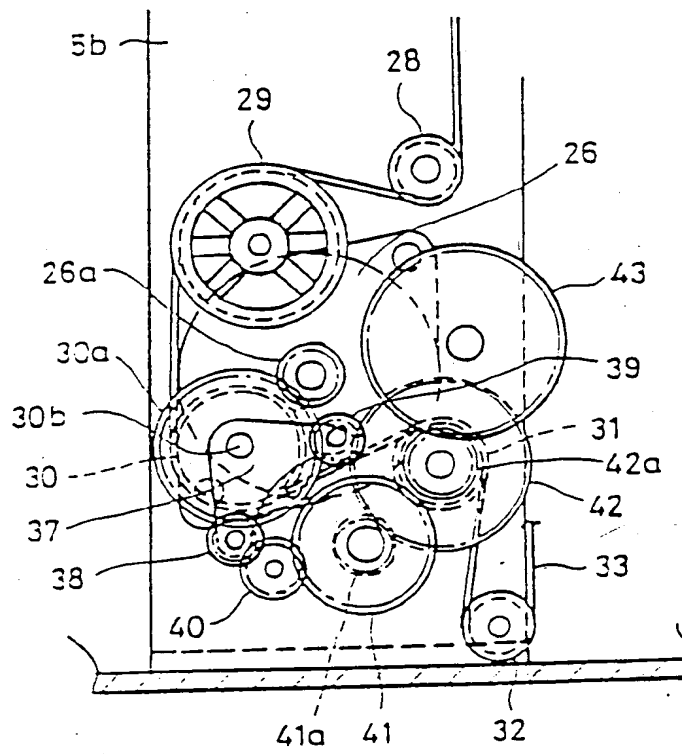


FIG. 6

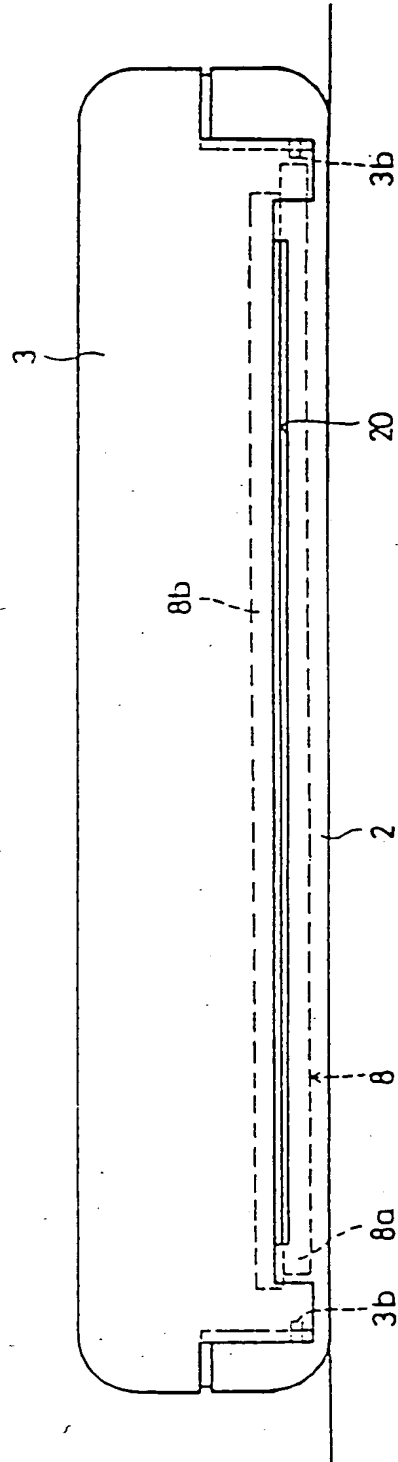
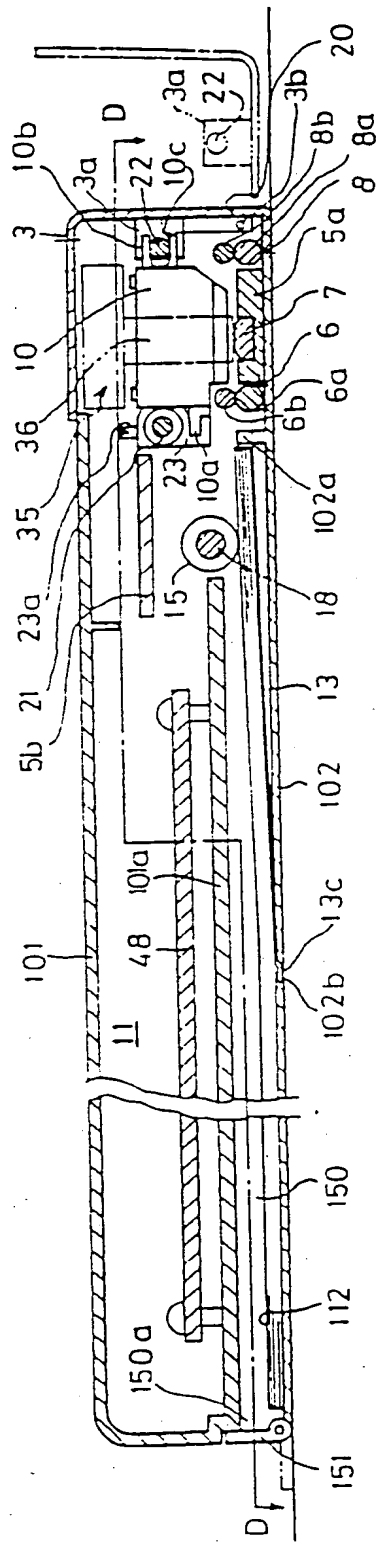
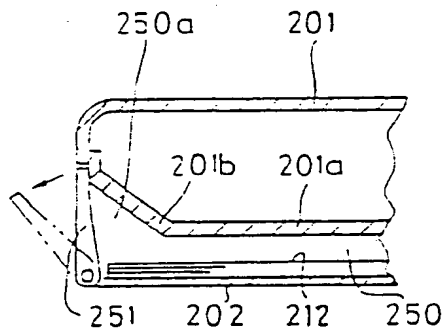


FIG. 7



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FIG. 9



DOT PRINTER

This invention relates to a dot printer.

5 In a conventional dot printer, a separate paper feed cassette is loaded into the printer, and paper is taken out of the paper feed cassette by a feed roller. Thereafter, the paper is fed by the feed roller between a platen and a printing head. Printing is then performed by the printing head. After the printing has
10 been effected, the paper is then discharged by a discharge roller.

The conventional dot printer is constructed as follows:

15 The paper feed cassette is loaded in a position under the printing head, or the printing head is disposed so as to face the platen in a horizontal direction. The feed roller and the discharge roller are placed on the upper and lower sides thereof. A problem with this construction is that the paper feed cassette,
20 the feed roller and the discharge roller are provided in a line in the vertical direction with respect to the printing head, which results in an increase in the total height of the printer.

25 It is an object of the present invention to provide a printer, such as a dot printer, which can have a thinner construction.

30 Although the present invention is primarily directed to any novel integer or step, or combination of integers or steps, herein disclosed and/or as shown in the accompanying drawings, nevertheless, according to one particular aspect of the present invention to which, however, the invention is in no way restricted, there is provided a printer comprising a platen and a printing

head encased within a printer case so as to face each other in a vertical direction; a paper housing portion provided upstream of and in line with the platen; a paper feed roller disposed upstream of and in line with the printing head for feeding paper taken out of the paper housing portion towards the printing head; and a discharge roller disposed downstream of and in line with the printing head for discharging paper printed by the printing head.

An advantage of the present invention is that the printing head and the platen are disposed opposite to each other in the vertical direction, and the paper housing portion, the feed roller and the discharge roller are arranged in line in the horizontal direction. Such components therefore have a compact arrangement in the vertical direction, and the overall printer can be made thinner.

The paper housing portion in the present invention may be a paper feed cassette loaded into the printer case or it may be encased within the printer case. In the latter instance, it is unnecessary to provide support means for holding the paper feed cassette in place. No extra cost need be incurred and no extra space need be employed.

If the paper housing portion is incorporated in the printer case, an upstream end of the paper housing portion is preferably closed by an openable cover for preventing dust and the like from entering the paper housing portion from the outside of the printer case.

Advantageously, the paper housing portion is arranged to occupy a plane parallel with that of a drive control circuit board of the printer. In this way, the paper housing portion may be disposed in a dead space peripheral to the circuit board, which renders

miniaturisation feasible.

The printer case is conveniently formed as a plane box-like structure in which an upper surface thereof is flat, so that a personal computer and the like can be placed on top of the printer case. This has advantages in terms of the installation space etc. needed for the printer.

The present invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a vertical section through a dot printer according to the present invention taken in a paper feeding direction;

Figure 2 is a section taken substantially along the line A-A of figure 1;

Figure 3 is a section taken substantially along the line B-B of figure 1;

Figure 4 is a section taken substantially along the line C-C of figure 1;

Figure 5 is an enlarged fragmentary view showing portions of the dot printer of figure 1 in the vicinity of a carriage motor and a ribbon driving gear train;

Figure 6 is a front elevation of the dot printer of figure 1;

Figure 7 is a sectional view corresponding to figure 1 showing another embodiment of dot printer according to the present invention;

Figure 8 is a section taken substantially along the line D-D of figure 7; and

Figure 9 is a fragmentary sectional view of a portion of a modification of the dot printer of figure 7.

Referring to figure 1, a printer case is composed of an upper casing 1 having a flat upper surface, a

lower casing 2 and a cover 3 provided at a front or downstream end of the upper casing 1 and the lower casing 2. The printer case has an external shape assuming a plane box-like configuration, in which the upper surface is flat. At the bottom of the lower casing 2, there is provided a loading unit for receiving a paper feed cassette 4, which serves as a paper housing portion of the printer. Support frames 5a and 5b are also fixed to the bottom of the lower casing 2.

The paper feed cassette 4 is disposed to the rear or upstream end of the bottom of the lower casing 2. Feed rollers 6, a platen 7 and discharge rollers 8 are disposed at the front or downstream end of the bottom of the lower casing 2. A printing head 10 is disposed vertically above the platen 7 so as to face the platen.

The paper feed cassette 4 is in the form of a box, wherein the upper surface is open. The cassette 4 is loaded from the direction of an arrow X. When the paper feed cassette 4 is loaded, its lower surface is substantially flush with the lower surface of the lower casing 2. More specifically, as illustrated in figure 4, a stepped portion 2a is formed in the loading unit for receiving the paper feed cassette 4. The paper feed cassette 4 engages with this stepped portion, whereby the lower surface thereof is substantially flush with the lower surface of the lower casing 2.

A drive control circuit board 48 is secured in a space 11, above the loading unit for receiving the paper feed cassette 4, in such a way that the circuit board overlies and is parallel with the paper feed cassette 4. Namely, the paper feed cassette 4 is so loaded into the printer case as to be overlapped with the circuit board 48. The circuit board 48 incorporates a control circuit for controlling the operations of a line feed motor 16

and a carriage motor 26, which will be mentioned later.

5 A stack of paper 12 is placed in the paper feed cassette 4 via the opening formed in the upper surface thereof. A hopper plate 13 (see figure 2) is attached to the bottom of the front part of the paper feed cassette 4. The hopper plate 13, as illustrated in figure 2, is T-shaped. An end 13c of the stem portion of the hopper plate 13 fits into a hole 4a formed in the paper feed cassette 4 and is supported for pivotal movement about an axis, whereby the hopper plate can swing upwards about this axis. Biasing means (not illustrated) are provided under the hopper plate for biasing the front part of the hopper plate upwards. In the loaded state of the paper feed cassette 4, the hopper plate 13 is pushed up by the biasing means, and the paper 12 is thereby urged against a pair of collection rollers 15.

10 As shown in figure 2, a shaft 17 for driving the collection rollers 15 is rotated through a gear train by the line feed motor 16, which is attached to an end of the support frame 5b at one side of the printer. A shaft 18, on whose ends the collection rollers 15 are fitted, is rotated by the drive shaft 17. Each collection roller 15 has a built in clutch (not illustrated). A sheet of paper 12 is drawn out from the paper feed cassette 4 by the collection rollers 15 and is supplied to the feed rollers 6, as described below. Thereafter, the collection rollers is run idle.

15 The support frame 5a is fixed at the bottom of the lower casing 2 at a position in front of the paper feed cassette 4. The platen 7 is secured to the support frame 5a in a sideways direction across the printer so that a contact surface for the paper 12 is directed upwards. In the front and rear of the platen 7, respectively, the feed rollers 6 and the discharge

rollers 8 are attached to the support frame 5a so as to extend parallel with the platen 7.

The feed rollers 6 and the discharge rollers 8 each comprise a lower driving roller 6a, 8a and an upper pinch roller 6b, 8b confronting the driving roller. A nip between the driving rollers and the pinch rollers is at substantially the same level as the level of the upper surface of the platen 7. The driving rollers 6a, 8a are also driven by the line feed motor 16 through a gear train (not shown).

Each of the driving roller 8a and the pinch roller 8b of the discharge rollers 8 assumes a virtually cylindrical configuration having a section uniformly continuous in the axial direction. An axial plane through the driving roller 8a and the pinch roller 8b faces and is parallel to an opening face of a discharge port 20 (see figure 6), which will be described below. The total sum of the diameters of the driving roller 8a and the pinch roller 8b is greater than a width of the discharge port 20. The length of each of the driving roller 8a and the pinch roller 8b is greater than the length of the discharge port 20. Hence, when viewing the discharge port 20 from the front of the printer (as in figure 6), the discharge port 20 appears to be blocked by the driving roller 8a and the pinch roller 8b.

The printing head 10 employs an impact system for effecting printing by thrusting out printing wires (not illustrated). The printing head 10 is guided for movement along a first guide shaft 21 and a second guide shaft 22, with its printing unit being directed downwards.

Slidably fitted on the first guide shaft 21 is a slider 23 having a hole therein with almost the same

diameter as that of the shaft and also a cylindrical member (not shown), formed of a synthetic resin or like and bonded to the inner surface defining the hole, for reducing friction. A groove is furrowed in a lower part of the slider 23. A protrusion 10a formed on a rear upright surface of the printing head 10 is fixedly fitted in this groove by means of a screw or the like (not shown). More specifically, one end of the printing head 10 is slidably supported on the first guide shaft 21 through the slider 23.

A receiving part 10b is formed internally with a front upright surface of the printing head 10 opposite to the surface to which the slider 23 is fixed. The receiving part 10b has a U-shaped groove 10c therein opening towards the front. The second guide shaft 22 is fitted in this groove 10c. The second guide shaft 22 is fixed to the cover 3 (see figure 6) in parallel with the first guide shaft 21 by means of a bracket 3a (the bracket 3a is omitted in figure 2), and the cover 3 is rotatably supported on the frame 5a through pins 3b.

The cover 3 assumes an L-shape in section and, as illustrated in figures 1 and 6, constitutes a front part of the upper surface of the printer case. In a state where the cover 3 is closed, the top of the cover engages the front end of the upper casing 1. When the cover 3 is opened, the front part of the interior of the printer case is exposed. In the closed state of the cover 3 as shown in figure 6, the edge of the front surface of the lower casing 2 confronts the edge of the front surface of the cover 3. In this confronting position, an elongate recess formed in the lower casing 2 combines with an edge of the front surface of the cover 3 to form a slit, which serves as the discharge port 20.

Next, a driving operation for the printing head 10 will be explained.

As illustrated in figure 2, a carriage motor 26 is mounted on an end portion of the support frame 5b adjacent a side of the printer. Pulleys 27, 28, 29, 30, 31 and 32 are also mounted on the frame 5b. The carriage motor 26 and the pulleys 27 to 32 are in a different plane from the plane including the displacement region of the printer head unit, ie. the displacement region of the printing head 10, the slider 23 and the receiving part 10b. The carriage motor 26 and the pulleys 27 to 32 are also disposed in positions which are not in the line of extension of the displacement region of the printer head unit, namely they are offset in the horizontal direction relative to the direction of movement of the printer head.

As fully illustrated in figure 5, the pulley 30 is integrally formed with a gear 30a meshing with a pinion 26a of the carriage motor 26. An U-shaped protrusion 23a is formed on an upper surface of the slider 23, and an endless timing belt 33 fits in the U-shaped protrusion 23a. The timing belt 33 is wound zig-zag about the pulleys 27 to 32. That is, the timing belt 33 is wound on the pulleys 29, 30 from the outside and on the pulleys 28, 31 from the inside. The timing belt 33 is also wound on the pulleys 27, 32 disposed at both ends of the support frame 5a from the outside, these pulleys stretching the belt 33 straight in the direction of the right and left sides of the printer from the position of the protrusion 23a. The timing belt 33 is driven by the carriage motor 26, and thereby the printing head 10 is driven. Note that the carriage motor 26 rotates both in a forwards and a reverse direction, and hence the printing head 10 performs a

reciprocating motion.

A ribbon cassette 35 is placed above the printing head 10. The ribbon cassette 35 has, as illustrated in figure 3, arms 35a at both sides of the printer. An ink ribbon 36 stretched on the arms 35a is located between the platen 7 and the printing head 10. A body 35c of the cassette 35 has a hollowed interior in which the ink ribbon 36, folded zig-zag, is accommodated. The ribbon cassette 35 can easily be loaded from the direction of the arrow Y in 31 when the cover 3 is in the open state. More specifically, the second guide shaft 22 is fixed to the cover 3 and is disengaged from the receiving part 10b in the open state of the cover 3. The printing head 10 is then supported only on the first guide shaft 21 and is rotatable about this axis. Hence, the ink ribbon 36 is easily set between the printing head 10 and the platen 7 by expanding the gap therebetween.

The driving operation of the ribbon cassette 35 will be described next. Referring to figure 5, an L-shaped lever 37 is attached to a shaft 30b of the pulley 30. Idlers 38, 39 are fitted to the two ends of this lever 37. The lever 37 rotates with the shaft 30b, by dint of friction, when the pulley 30a rotates.

When the pulley 30 rotates anticlockwise, the lever 37 undergoes an anticlockwise rotation due to the frictional force. Then, the idler 38 meshes with a gear 40. The gear 40 engages with a gear 41. A pinion 41a of the gear 41 meshes with a gear 42, which is co-axial with the pulley 31 (the pulley 31 and the gear 42 are co-axial with each other but rotate separately). A pinion 42a of the gear 42 meshes with a ribbon driving gear 43, which is thereby rotated clockwise. Conversely, when the gear 30 rotates clockwise, the idler 39 engages with the gear 41 to rotate the same.

Hence, the ribbon driving gear 43 also rotates clockwise.

5 The ribbon cassette 35 incorporates a pair of ribbon feed rollers (not illustrated) meshing with the ribbon driving gear 43. The ink ribbon 36 is moved along the arms 35a by the ribbon feed roller. Note that the ink ribbon 36 is vertically accommodated in the body 35c of the ribbon cassette 35 and is twisted at a right angle when being engaged over the arms 35a from within the body 35c.

10 During a printing operation, the sheets of paper 12 in the paper feed cassette 4 are drawn out by the collection rollers 15. The supplied sheet of paper 12 is fed substantially horizontally between the head 10 and the platen 7 by means of the feed rollers 6. The printer wires located in the printing head impinge on the paper 12 via the ink ribbon 36 in response to a printing signal, thus effecting the printing. The sheet of paper 12, after being printed, is fed substantially horizontally to the discharge rollers 8 by dint of continuing force from the feed rollers 6. The sheet of paper 12 passes through the discharge rollers 8 and emerges substantially horizontally from the discharge port 20.

25 In the printer employed in this manner, the printer head 10 is disposed upwardly of the platen 7 so as to confront the platen 7. The paper feed cassette 4, the feed rollers 6 and the discharge rollers 8 are disposed in a horizontal line upstream and downstream of the platen 7. With this arrangement, the components are located compactly in the vertical direction. Therefore, the printer can be made thinner.

30 The printer case has a plane box-like configuration, in which the upper surface is flat. With

this arrangement, a personal computer, a word processor and the like can be placed on the printer case. The printer case is thus convenient in terms of installation space, operability and so on.

5 The paper feed cassette 4 is loaded in such a way that the cassette lies parallel with the circuit board 48 on the bottom of the printer case. The paper feed cassette is thus installed without taking up substantial volume in the printer case. Besides, the paper feed cassette 4 is disposed in a dead space peripheral to the 10 circuit board 48. Hence, no increase the size of the printer case is needed and the printer case can be miniaturised.

15 In this embodiment, the paper feed cassette 4 is loaded on the bottom of the printer case but it may also be loaded horizontally or sideways from the upstream side of the printing head and the platen. For instance, the paper feed cassette may be loaded in a space 11 formed at the top of the printer case, and the circuit board 48 may be placed in a position lower than the 20 cassette. As far as the loading direction of the paper feed cassette is concerned, the cassette may for example also be loaded in a direction at right angles to the plane of the drawing in figure 1 or from the underside in figure 1.

25 Another embodiment of the present invention will be described with reference to figures 7 and 8. Parts which are the same as those shown in figures 1 to 6 are designated by the same reference numerals and will not be described in detail.

30 In this embodiment, a paper housing portion 150 is formed between a rear or upstream end of a lower casing 102 and a bottom 1021a of an upper casing 101 such that the paper housing portion 150 overlaps the circuit board

48 to the rear of the platen 7. A rear end 150a of the paper housing portion 150 is openable. The support frame 5b is fixed on the frontal downstream end of the upper casing 101. The support frame 5a is fixed to the bottom of the lower casing 102 at its front end. A protrusion 102a for limiting a stack of paper 112 at the front is provided on an upper surface of the lower casing 102.

An openable/closeable cover 151 for opening and closing the opening 150a of the paper housing portion 150 is provided at the rear end of the lower casing 102. The stack of paper 112 is loaded into the paper housing portion 150 by way of the opening 150a. A hopper plate 13 (see figure 8) is attached to the lower casing 102 and has a T-shaped configuration. An end 13c of the stem portion thereof is fitted in a hole 102b formed in the lower casing 102 and is supported along an axis such that the hopper plate is pivotable about this axis.

In this printer, as shown in figure 7, the cover 151 is at first opened to load the paper 112 into the paper housing portion 150 from the rear end of the printer. The front end of the stack of paper 112 contacts the protrusion 102a with the result that the paper 112 cannot move further forwards. The paper 112 is thus positioned within the printer and housed in the paper housing portion 150.

Thereafter, dust and the like is prevented from entering the paper housing portion 150 from the outside of the printer by closing the cover 151.

Hence, in this embodiment, the printer case incorporates the paper housing portion 150 but does not require an additional support mechanism for holding a separate paper feed cassette. No extra cost and no extra space are needed.

Note that, in this embodiment, the paper housing portion 150 is provided on the bottom of the printer case, but it may also be provided on the upstream side of the platen 7 within the printer case. The invention is not limited to this embodiment. Further, the cover for closing the opening 150a may be omitted.

Still another embodiment of the present invention will be described with reference to figure 9, in which a modification of the arrangement of figure 7 and 8 is illustrated.

A rear or upstream end 201b to a bottom 201a of an upper casing 201 is inclined upwards. A rear end of a paper housing portion 250 provided between the bottom 201a and a lower casing 202 is thereby formed with an entrance 250a, whose opening is wider than the height of the paper housing portion 250.

An openable/closeable cover 251 for covering the entrance 250a is provided at a rear end of the lower casing 202. The cover 251 is, as indicated by a chain-dotted line, limited in its opening movement, so as to stop obliquely at an open angle of 90° or less, by means of a snap limiter or stop (not shown).

When loading paper 212 into the printer, the cover 251 is opened obliquely. The paper 212 is thereby guided obliquely by the rear end 201b of the bottom 201a of the upper casing 201 and by the cover 251 as well. The paper 212 can be inserted obliquely into the printer. It is, therefore, possible to reduce the space required at the upstream end of the printer for feeding the paper in. The printer can thus be installed so that, for example, the rear part of the printer is positioned very close to a wall, whereby the overall space needed for the printer can be reduced.

In the embodiments described above, the printing

head is disposed above the platen so as to face downwards. The printing head may, however, be disposed under the platen so as to face upwards.

5 The embodiments described above involve the use of an impact type head for effecting printing by ejecting the printing wires. However, as a matter of course, other printing arrangements may be adopted in which, for example a thermal transfer head is used.

10 As discussed above, in the dot printer according to this invention, the components such as the paper housing portion, the platen, the printing head, the feed roller and the discharge roller are arranged compactly in the vertical direction. The printer can therefore be made thinner.

15 The paper housing portion in one embodiment is incorporated into the printer case, and the paper is housed in the paper housing portion in the printer case. Hence, it is unnecessary to provide support means for holding a paper feed cassette. No extra cost and no extra space are required. The dot printer can thus be
20 miniaturised, resulting in a decrease in cost. When encasing the paper housing portion in the printer case, the rear or upstream end of the paper housing portion is openable, and has a cover for preventing dust and the like for entering the paper housing portion from the
25 outside of the printer case.

30 The paper housing portion is preferably arranged within the printer case so as to lie parallel with the drive control circuit board. With this arrangement, the paper housing portion is placed in the dead space peripheral to the circuit board, thereby assisting in the miniaturisation of the printer. The printer case is advantageously shaped in a plane box-like configuration, in which the upper surface is flat. A personal computer

and the like can therefore be placed on the printer case, which is convenient in terms of installation space etc.

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CLAIMS

1. A printer comprising a platen and a printing head
encased within a printer case so as to face each other
5 in a vertical direction; a paper housing portion
provided upstream of and in line with the platen; a
paper feed roller disposed upstream of and in line with
the printing head for feeding paper taken out of the
paper housing portion towards the printing head; and a
10 discharge roller disposed downstream of and in line with
the printing head for discharging paper printed by the
printing head.
2. A printer as claimed in claim 1 in which the paper
housing portion comprises a removable paper feed
15 cassette loaded into the printer case.
3. A printer as claimed in claim 1 in which the paper
housing portion is encased within the printer case.
4. A printer as claimed in claim 3 in which an
upstream end of the paper housing portion is closed by
20 an openable cover.
5. A printer as claimed in any of claims 1 to 4 in
which the paper housing portion is arranged so as to be
overlapped in a plane with a drive control circuit board
of the printer.
6. A printer as claimed in any of claims 1 to 5 in
25 which the printer case has a plane box-like
configuration with a flat upper surface.
7. A printer as claimed in any preceding claim
comprising a dot printer.
8. A dot printer comprising a platen and a printing
30 head so encased in a printer case as to confront each
other in the vertical direction; a paper housing portion
provided sideways from the upstream side of said platen;

5 a feed roller disposed in line sideways from the upstream side of said printing head, for feeding a paper taken out of said paper housing portion towards said printing head; and a discharge roller, disposed in line sideways from the downstream side of said printing head, for discharging outside said a paper printed by said printing head.

9. A printer substantially as herein particularly described with reference to and as illustrated in figures 1 to 6 of the accompanying drawings, or figures 7 and 8 of the accompanying drawings, or figures 7 and 8 when modified by figure 9 of the accompanying drawings.

10. Any novel integer or step, or combination of integers or steps, hereinbefore described and/or as shown in the accompanying drawings, irrespective of whether the present claim is within the scope of or relates to the same, or a different, invention from that of the preceding claims.